

1. The Sun has a surface temperature of 5000K, Earth has an average temperature of 15°C, and you have a surface(skin) temperature of 34°C  
Radius of Sun - 695 500km  
of Earth  $6.37 \times 10^6 \text{m}$   
Radius of you? guestimate  
distance between Earth/sun  $1.50 \times 10^{11} \text{m}$

a) What is the total power output of Sun (treat as perfect blackbody  $e=1$ ), Earth  $e=0.50$ , you  $e=0.98$ ?

$$P = e\sigma AT^4$$

$$\sigma = 5.67 \times 10^{-8} \text{ Wm}^{-2}\text{K}^{-4}$$

$$A = 4\pi r^2 = 4 \times 3.14159 \times 6.955 \times 10^8^2 = 6.07860 \times 10^{18} \text{ m}^2 \text{ Sun}$$

$$4 \times 3.14159 \times 6.37 \times 10^6^2 = 5.09904 \times 10^{14} \text{ Earth}$$

you = 1.7 m<sup>2</sup> ? ish

$$P = 1 \times 5.67 \times 10^{-8} \times 6.07860 \times 10^{18} \times 5000^4 = 2.15410 \times 10^{26} \text{ W Sun}$$

$$P = 0.5 \times 5.67 \times 10^{-8} \times 5.09904 \times 10^{14} \times 288^4 = 9.94515 \times 10^{16} \text{ W Earth}$$

$P = 0.98 \times 5.67 \times 10^{-8} \times 1.7 \times 10^7^4 =$   
 $839 \text{ W}$  ??? way too high people are  
 about 50-100W e seems way off  
 internet says that 839 W naked is  
 reasonable

b) peak wavelength for Sun, Earth, you

$$\lambda_{\max} = 2.9 \times 10^{-3} / T$$

sun =  $2.9 / 5 = 0.58 = 0.58 \text{ micro meters}$   
 green light (why isn't the sun green?)

$2.9 / 0.288 = 10.0694 = 10 \text{ micro meters}$   
 infrared heat - wavelength resonates  
 with greenhouse gasses (think masses  
 and springs)

$2.9 / 0.307 = 9.4463 \text{ 9 micro meters}$   
 infrared

c) What is the power input from the sun on  
 the Earth? treat the Earth like a disk  
 $1.50 \times 10^{11} \text{ m}$  from the Sun with the  
 energy spread over a sphere. What is  
 the Intensity?  $= P/A$

Area of sphere  $1.5 \times 10^{11} \text{ m}$  in radius  
 $4 \times 3.14159 \times 1.5 \times 10^{11}^2 = 2.82743 \times 10^{23}$

$$I = 2.15410E26 / 2.82743E23 = 761.85794 \text{ W/m}^2$$

$$P = 761.85794 \times 3.14159 \times 6.37E6^2 = 9.71186E16 \text{ W total on the Earth}$$

- d) What albedo for the Earth would allow the power input from c to balance the power output of the Earth from a?  
output > input so a would have to be negative to balance - doesn't make sense unless you include greenhouse gasses
- e) given your answer to b) why are greenhouse gasses (carbon dioxide, methane, water...) effective at absorbing heat from the Earth? - resonance
- f) bonus - what would be the temperature of the Earth if there was no atmosphere and no albedo?

Q15+16 on energy production handout

next class - turbines + energy sources  
Tuesday Lab  
Thursday breakie

Monday, Wednesday review  
Friday ProD  
IB exams